



[4910–13]

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Waivers of Ship Protection Probability of Impact Requirement

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of waivers.

SUMMARY: This notice concerns two petitions for waiver submitted to the FAA by Space Exploration Technologies Corp. (SpaceX): A petition to waive the requirement that a waiver request be submitted at least 60 days before the effective date of the waiver unless good cause for later submission is shown in the petition; and a petition to waive the requirements that exclude persons in waterborne vessels from the collective risk criteria and limit the probability of impact on waterborne vessels to 1×10^{-5} .

FOR FURTHER INFORMATION CONTACT: For technical questions concerning this waiver, contact Paul D. Wilde, Deputy Chief Engineer, Commercial Space Transportation, 800 Independence Avenue, S.W., Washington, DC 20591; telephone: (202) 267-5727; e-mail: Paul.Wilde@faa.gov. For legal questions concerning this waiver, contact Laura Montgomery, Office of the Chief Counsel, Regulations Division, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, DC 20591; telephone (202) 267-3150; e-mail: Laura.Montgomery@faa.gov.

SUPPLEMENTARY INFORMATION:

Background

On April 1, 2016, SpaceX submitted a petition to the Federal Aviation Administration's (FAA's) Office of Commercial Space Transportation (AST) requesting relief from a regulatory requirement for a launch license for flight of a Falcon 9 launch vehicle carrying SpaceX's Dragon capsule. Specifically, SpaceX requested relief from 14 CFR 417.107(b), which excludes persons in waterborne vessels from the collective risk limit of 30×10^{-6} expected casualties (E_C) and limits the probability of impact with waterborne vessels to 1×10^{-5} .¹ The FAA is treating the request for a waiver to also apply to Appendix B to part 417, paragraph 417.5(a), which requires evacuation and monitoring of hazard areas. The launch operator does not initiate flight until the hazard area clears when the area cannot be evacuated. Because the scheduled launch was planned to occur in less than sixty days, SpaceX also requested a waiver to § 404.3(b)(5), which requires that a petition for waiver be submitted at least sixty days before the proposed effective date of the waiver, which in this case would be the date of the planned launch.

The FAA licenses the launch of a launch vehicle and reentry of a reentry vehicle under authority granted to the Secretary of Transportation in the Commercial Space Launch Act of 1984, as amended and re-codified by 51 U.S.C. Subtitle V, chapter 509 (Chapter 509), and delegated to the FAA Administrator and the Associate Administrator for Commercial Space Transportation, who exercises licensing authority under Chapter 509.

SpaceX is a private commercial space flight company. The petition addresses an upcoming flight that SpaceX plans to undertake to deliver the cargo inside the Dragon capsule to the International Space Station (ISS) as its eighth Commercial Resupply Service mission (CRS-

¹ In 2014, the FAA proposed to clarify the requirements of part 417 concerning hazard areas for ships and aircraft. *Notice of Proposed Rulemaking, Changing the Collective Risk Limits for Launches and Reentries and Clarifying the Risk Limit Used to Establish Hazard Areas for Ships and Aircraft*, 79 FR 42241 (July 21, 2014). The proposed clarification provided in the 2014 NPRM was that "A launch operator must establish any water borne vessel hazard areas necessary to ensure the probability of impact (P_i) with debris capable of causing a casualty for water borne vessels does not exceed 0.00001 (1×10^{-5})." *Id.* at 42253.

8). SpaceX plans for its Falcon 9 launch vehicle to launch from Cape Canaveral Air Force Station (CCAFS) and fly back the first stage to a barge for landing. During a previous launch of the Falcon 9 from CCAFS to deliver the SES-9 payload to orbit, SpaceX was delayed by the presence of a tug boat towing a large barge inside the ship hazard area in compliance with the FAA's requirement in § 417.107(b) to limit the probability of impact for waterborne vessels to 1×10^{-5} .

Waiver Criteria:

Chapter 509 allows the FAA to waive a license requirement if the waiver (1) will not jeopardize public health and safety, safety of property; (2) will not jeopardize national security and foreign policy interests of the United States; and (3) will be in the public interest. 51 U.S.C. 50905(b)(3) (2011); 14 CFR 404.5(b) (2011).

Section 404.3(b)(5) Waiver Petition

Section 404.3(b)(5) requires that a petition for waiver be submitted at least sixty days before the proposed effective date of the waiver. This section also provides that a petition may be submitted late if the petitioner shows good cause.

Here, SpaceX submitted its waiver petition on April 1, 2016, for the F9 CRS-8 mission, which was less than sixty days from its planned April 8, 2016 launch date. However, SpaceX initially submitted a request on January 19, 2016, for its Falcon 9 launches, which included the CRS and geosynchronous transfer orbit (GTO) missions. In response to the January 19 waiver petition, the FAA informed SpaceX that it was unable to grant that request for relief because the FAA did not have adequate time to complete its evaluation of the petition, but would keep SpaceX abreast of its findings once the evaluation was completed. The FAA has been considering the issues raised since January and is now able to address them, and advised SpaceX

of that. Accordingly, the FAA is able to find good cause because SpaceX's January 19 waiver petition covered the F9 CRS missions, including CRS-8.

Section 417.107(b) Waiver Petition

Section 417.107(b) allows a launch operator to initiate flight only if the risk associated with the total flight to all members of the public, excluding persons in waterborne vessels and aircraft, does not exceed an expected average number of 0.00003 casualties ($E_C \leq 30 \times 10^{-6}$) from impacting inert and impacting explosive debris, ($E_C \leq 30 \times 10^{-6}$) for toxic release, ($E_C \leq 30 \times 10^{-6}$) and for far field blast overpressure.

Additionally, a launch operator must implement water borne vessel hazard areas that provide an equivalent level of safety to that provided by water borne vessel hazard areas implemented for launch from a Federal launch range.²

Launch of the Falcon 9 Vehicle

The FAA does not need to address SpaceX's request to waive the exclusion of people in waterborne vessels from the risk limits of § 417.107(b). That exclusion is not a requirement that can be waived, but merely a statement that the collective risk requirement does not apply to persons in waterborne vessels. Accordingly, this waiver only addresses the requirement that a launch operator must ensure the probability of impact (P_i) with debris capable of causing a casualty for water borne vessels does not exceed 1×10^{-5} . The FAA grants SpaceX's request for a waiver for the Falcon 9 CRS-8 launch because it is in the public interest and will not jeopardize

² In 2014, the FAA proposed a clarification of this requirement. "Under proposed section 417.107(b)(3), a hazard area for water borne vessels would satisfy part 417 if the probability of impact with debris capable of causing a casualty on any given water borne vessel did not exceed 0.00001 (1×10^{-5})."
Id. at 42244. The FAA explained that § 417.107(b)(3) permits a launch operator to set a hazard-area level of safety that is equivalent to the one used by federal launch ranges with the least burdensome hazard area limit. While each federal launch range has its own safety criteria for hazard areas, the federal launch range with the least burdensome limit for hazard areas imposes a probability of impact (P_i) limit of 1×10^{-5} for water-borne-vessel hazard areas. *Id.* at 42249-50.

public health and safety, safety of property, or national security or foreign policy interests of the United States.

i. Public Health and Safety and Safety of Property

The Falcon 9 CRS-8 launch is the ninth launch of an expendable launch vehicle with a Dragon capsule bound for the ISS. SpaceX has attempted three landings of its Falcon 9 first stage on a barge on the ocean off CCAFS. The stages reached their intended landing spot, but did not survive the landings. In no case was public health or safety or safety of third party property jeopardized. The USAF conducted an assessment of the collective risk to people on land due to debris from the CRS-8 launch and has determined that the risks are about half the FAA's current³ regulatory limit of 30×10^{-6} Ec.

On September 25, 2006, the FAA issued part 417 to amend its commercial space transportation regulations governing the launch of expendable launch vehicles. The FAA requirements in part 417 have their genesis in USAF range safety requirements.

In addition to the public risk criteria provided in § 417.107(b), flight hazard areas were a key element of the performance level requirements in subpart C of 417 to ensure the safety of people on waterborne vessels. Specifically, § 417.223(a) states that *“a flight safety analysis must include a flight hazard area analysis that identifies any regions of land, sea, or air that must be surveyed, publicized, controlled, or evacuated in order to control the risk to the public from debris impact hazards. The risk management requirements of § 417.205(a) apply.”* In addition to the performance level requirements of subpart C of part 417, the FAA included several appendices on flight safety analysis methods. Specifically, Appendix B to part 417,

³ In 2014, the FAA proposed to update this requirement as explained in *Changing the Collective Risk Limits for Launches and Reentries and Clarifying the Risk Limit Used to Establish Hazard Areas for Ships and Aircraft*, Notice of Proposed Rulemaking, 79 FR 42241 (July 21, 2014).

paragraph 417.5(a) states that “*a launch operator must perform a launch site hazard area analysis that protects the public, aircraft, and ships from the hazardous activities in the vicinity of the launch site. The launch operator must evacuate and monitor each launch site hazard area to ensure compliance with §§ 417.107(b)(2) and (b)(3).*” The methodology in Appendix B was designed to be consistent with USAF range safety requirements in 2006, and to ensure that the cumulative probability of impact to any ship would not exceed 1×10^{-5} for any debris expected to exceed the kinetic energy or overpressure thresholds established by § 417.107(c).

At the time that part 417 was promulgated, safety experts at NASA⁴ believed that it would be desirable to apply collective risk⁵ management principles to ship safety by including persons in waterborne vessels in the E_C calculation. However, the computational tools and input data available at that time made it impractical, and posed significant risks to launch operators,⁶ to quantify the E_C contribution from people in waterborne vessels. Specifically, the means to survey ship traffic areas potentially threatened by launch debris were much more limited in the 2006 timeframe as explained below. Accordingly, the Federal launch ranges and the FAA adopted the cumulative probability of impact as a surrogate for collective risk and relied on a relatively simplistic approach involving ship hazard areas. Thus, the FAA’s current requirements allow launches to proceed with unquantified residual collective risks to people in waterborne vessels.

⁴ For example, the NASA Range Safety Policy requirements (NPR8715.5 dated July 8, 2005 in paragraph 3.2.6.2) stated that “an assessment of risk to the public and workforce due to debris shall account for ...all potential debris, generated intentionally or not, that could cause a casualty, including debris that could affect someone on the ground *or on a waterborne vessel*, or cause an aircraft accident (Requirement).”(emphasis added).

⁵ Risk metrics account for both the probability and consequence of foreseeable events. In contrast to the relatively sophisticated casualty consequence models that must be used to compute individual and collective risks according to § 417.107(d), the FAA’s current requirements restrict only the probability of impact on waterborne vessels with only simple threshold values to define what constitutes an “impact.”

⁶ The only known deaths related to launch operations at Cape Canaveral were five occupants of a helicopter that crashed at sea “shortly after 2 a.m., Saturday, April 7, [1984] while flying surface surveillance for the scheduled launch of a Trident 1 missile from the USS Georgia.” See Air Force News Print Today (Apr. 8, 2011).

Since 2006, when the part 417 requirements were promulgated, the capability to compute launch risks to people on waterborne vessels has improved greatly. The U.S. Coast Guard now requires in 33 CFR § 164.46 that waterborne vessels above a certain size operate a properly installed and approved Automatic Identification System (AIS), a ship and shore based broadcast system. The AIS, combined with other technological advances, now makes real-time ship information readily available, including the position, course, speed, ship size, identity, and cargo data. The real-time data on waterborne vessels provided by AIS and other advanced surveillance techniques, combined with advanced computer models, now enable valid estimates of the individual and collective risks to people on waterborne vessels to be made during a launch countdown.

The FAA has assessed the input data and probabilistic casualty models that the U.S. Air Force at the 45th Space Wing (45th SW) will use to quantify individual and collective risks to people on waterborne vessels during the launch countdown for the CRS-8 mission. The FAA found that the 45th SW's public risk analyses use accurate data and scientific methods that are mathematically valid, with reasonably conservative assumptions applied in areas where significant uncertainty exists. For example, the 45th SW uses conservative estimates of the number of occupants on waterborne vessels by assuming that the number of persons on board equals the vessel's maximum capacity and that all occupants are on-deck, and thus exposed to debris impacts that might not otherwise pose a threat to people below deck. Additionally, the FAA performed independent analyses using alternative methods to estimate the casualty risks for multiple foreseeable scenarios involving debris impacts on various types of waterborne vessels in the vicinity of Cape Canaveral. The FAA found that large passenger vessels anywhere between the launch point and the first stage disposal zone can contribute significantly to the estimated E_C

from the CRS-8 launch. The FAA found that small boats (too small to have AIS required) located close to the launch point should not produce significant individual risks, given conditions expected in the vicinity of Cape Canaveral. Specifically, sufficient surveillance with other means (e.g., radar, and/or using Coast Guard ships or aerial assets) will be used to ensure individual risks comply with the FAA requirement in § 417.107(b)(2). In addition, Notices to Mariners will continue to be issued for the areas where the probability of impact on a ship would exceed 1×10^{-5} , which is current practice at the ER, and required by §§ B417.3 and B417.11. Since the FAA's current requirements allow launches to proceed with unquantified residual collective risks to people in waterborne vessels, as long as the collective risk for people on land from each source of hazard (i.e., debris, toxics, or distant focusing overpressure) does not exceed $30 \times 10^{-6} E_C$, and because the launch will not exceed the $30 \times 10^{-6} E_C$ with the inclusion of persons on water borne vessels, the FAA finds that the Falcon 9 CRS-8 launch will not jeopardize public health and safety or safety of property, and waives 14 CFR 417.107(b)(3) and Appendix B to part 417, paragraph 417.5(a)'s requirement not to initiate flight absent evacuation .

National Security and Foreign Policy Implications

The USAF conducted an assessment of the risk to property on CCAFS, including assets used for national security space missions, and did not identify national security concerns. The FAA has identified no national security or foreign policy implications associated with granting this waiver.

ii. Public Interest

The waiver is consistent with the public interest goals of Chapter 509 and the 2013 National Space Transportation Policy. Three of the public policy goals of Chapter 509 are: (1) to promote economic growth and entrepreneurial activity through use of the space environment; (2)

to encourage the United States private sector to provide launch and reentry vehicles and associated services; and (3) to facilitate the strengthening and expansion of the United States space transportation infrastructure to support the full range of United States space-related activities. See 51 U.S.C. 50901(b)(1), (2), (4). Commercial Space Transportation Licensing Regulations, Notice of Proposed Rulemaking, 62 FR 13230 (Mar. 19, 1997). A successful application of public risk management for the protection of people in waterborne vessels has the potential for reducing launch costs. As it is a major procurer of launch services, reduced launch costs will be of direct benefit to the U.S. Government. It will also help to make the U.S. launch industry more competitive internationally. The 2013 National Space Transportation Policy clearly identifies how strengthening U.S. competitiveness in the international launch market and improving the cost effectiveness of U.S. space transportation services are in the public interest: “Maintaining an assured capability to meet United States Government needs, while also taking the necessary steps to strengthen U.S. competitiveness in the international commercial launch market, is important to ensuring that U.S. space transportation capabilities will be reliable, robust, safe, and affordable in the future. Among other steps, improving the cost effectiveness of U.S. space transportation services could help achieve this goal by allowing the United States Government to invest a greater share of its resources in other needs such as facilities modernization, technology advancement, scientific discovery, and national security. Further, a healthier, more competitive U.S. space transportation industry would facilitate new markets, encourage new industries, create high technology jobs, lead to greater economic growth and security, and would further the Nation’s leadership role in space.” SpaceX’s proposal to apply collective risk management to people in waterborne vessels is in the public interest.

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